# Topographic Maps

**Strand** Scientific Investigation

**Topic** Developing Map Skills

**Primary SOL** ES.1 The student will plan and conduct investigations in which

a) volume, area, mass, elapsed time, direction, temperature, pressure, distance, density, and changes in elevation/depth are calculated utilizing the most appropriate tools;

c) scales, diagrams, charts, graphs, tables, imagery, models, and profiles are constructed and interpreted;

d) maps and globes are read and interpreted, including location by latitude and longitude.

**Related SOL** ES.2 The student will demonstrate an understanding of the nature of science and scientific reasoning and logic. Key concepts include

a) science explains and predicts the interactions and dynamics of complex Earth systems;

c) observation and logic are essential for reaching a conclusion.

**Background Information**

After general cartography techniques were established, the next step in the evolution in map making was the creation of relief or topographic maps to show elevation changes. Prior to the topographic map, it was impossible to feature true representations of the scale of any landform, other than in symbolic fashion. In order to create a topographic map, contour lines of like evolution are drawn. There is a set elevation change from contour line to contour line. This means that as you move from one line to the next you are either increasing or decreasing in elevation. Another important feature in this style of map is the ability to show the severity of an incline. The closer the lines are together the steeper the incline, and the further apart they are the gentler the incline.

When students know what is involved in creating a representational map, they are more likely to understand how to analyze geographic information included in maps. Therefore, after crafting hilltops, streams, and valleys out of clay, they will translate these features into topographic or contour maps. These maps will include major features and information, such as date, orientation, grid, scale, title, author, index, legend, and sources (identified by the acronym “DOGSTAILS”).

**Materials**

- USGS quadrangle topographic map (7.5-minute series) of your area
  - USGS maps and information - http://topomaps.usgs.gov/
  - USGS map locator and Downloader - http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do
  - USGS Quad Locator - http://www.usgsquads.com/index.php/map-indexes/mapfinder/
- Sticks
- Clay

- Colored pencils
- Drawing paper
- Rulers
- Thin fishing line

**Vocabulary**

*contour interval, contour line, elevation, relief, scale, topographic map*

**Student/Teacher Actions (what students and teachers should be doing to facilitate learning)**

*Introduction*

1. Using simple shapes such as a cone and pyramid, predraw the figure as if you were looking straight down on the item drawn in contour lines. These lines do not have to be at any specific intervals, just evenly spaced.
2. Show the class these images. Have them break into groups and draw the images on their own sheet of paper or science journal. They will need to include a key with their drawing. They will have to include their own elements on the key to explain to others what is being drawn.
3. Next to their drawing, the students will need to draw a profile of the image with indicators that represent the other lines they see in the image that you provided to them.
4. Since there are many homes built in scenic locations along various landforms, have students draw the best location for a house, driveway, and garage on their topographic maps.
5. Be sure to include these new map features in your key.

*Procedure*

1. Discuss some common kinds of landforms, such as hills, mountains, valleys, and plateaus. Ask what distinguishes hilly or mountainous terrain from relatively flat terrain. Explain that the amount of relief is the amount of elevation change in the land surface within a given area. Explain that it is sometimes important to have a map that shows the elevation of land on a flat paper surface—a topographic map. Ask why this is useful. Ask the students if it is reasonable for hikers to carry small, three-dimensional models of the hills they are walking.
2. Show students a topographic map of your area. Help them understand the contour lines and how to identify land features by the spacing of the contour lines.
3. Set the clay in a sunny window to warm it, or use a lamp or heat register. Knead the clay until it is very soft, break it into lumps, one per student group, and place each lump on a sheet of drawing paper.
4. Provide each group with a USGS quadrangle topographic map.
5. Distribute the materials to the groups, and encourage them to shape their clay into a mountain, marking the peak with a dot. Encourage them to make the mountain look as realistic as possible to include secondary peaks, valleys, and sheer walls and faces, and not like a regular cone.
6. Have each group draw a straight line on the paper that runs from North to South across the mountain and passes through the dot. Have them draw a second line perpendicular to the

first line and running East to West through the dot. The mountain should now appear to be divided into quadrants. These quadrant lines will be important later.

7. Have each group draw three rings around the dot. One ring should be a quarter of the way down the mountain from the peak; the next should be halfway down; and the third should be three-quarters of the way down.
8. Give each group a piece of fishing line, and explain how they should hold it taut and use it like a knife to slice horizontally through the clay along the ring lines they have just drawn. They should wind up with four mountain layers, which they should carefully separate and set aside separately.
9. Have students place the bottom mountain layer on a fresh sheet of paper and outline it, making sure to mark the places where the north-south and east-west quadrant lines meet the paper.
10. Have students remove that layer from the paper and center the next layer within the outline, using the quadrant lines to make sure it has the right north-south and east-west positions. Have them outline this layer. Then, have them repeat this process with the two remaining layers.
11. After the groups have removed their last layers, explain that they have begun making topographic maps. Tell students to assume that the base of the mountain is at sea level. Have them assign elevations to the four levels of the mountain (intervals must be consistent). Then, have them color each layer and create a map key. (Caution them against using blue, which is reserved for representing water.)
12. Have the students reconstruct their landform. Once reconstructed, use the fishing line and cut a slice vertically through the clay along one of the lines that were drawn on their original map. Separate the two pieces, and have the students draw a profile of the clay landform. They will need to indicate contour lines and elevations on this image.
13. Have the groups add DOGSTAILS to their maps—the other map essentials: date, orientation, grid, scale, title, author, index, legend, and sources.
14. Looking back at your prelesson activity of locating a house, driveway, and garage, explain in a paragraph why you located these items in their locations on your map. Do you think that there will be problems with your locations? What could be done to fix these things? Is it even feasible to have a home on your landform?

**Assessment**

- **Questions**
  - Using the clay creation of a student's landform, where would you place a home, driveway, and garage? Is this in the same locations as the original landform creator?
- **Journal/Writing Prompts**
  - Ask the students to write an explanation of how to create a topographic map with certain features. The students should use the terms vocabulary terms listed.
- **Other**
  - Display several of the student-made topographic maps. Have student groups defend the creation of their topographic maps based on the construction of their clay mountains.

- Hold a class discussion of the relationship between the clay mountain and the mapped representation of it. Center discussion on an explanation of what would change on the map if something were changed on the model. Student understanding should translate into real map reading, enabling them to predict the shape, and relief of a real landform by looking at a topographic map of it.
- Have students demonstrate understanding of topographic maps by exchanging maps and then creating the new clay mountains based on the topographic maps of them.

**Extensions and Connections (for all students)**

- Have students select a line along a student-created topographic map and construct a topographic profile for it without cutting the landform vertically. As they construct their profiles, have the students practice expository writing by compiling procedural steps. Once the procedural steps are complete, have students exchange written procedures for verification and replication.

**Strategies for Differentiation**

- Conduct a gallery walk in the classroom for students to match drawn topographic maps with their corresponding three-dimensional clay models. Have one student remain with each three-dimensional model to act as an expert on the team's landform.
- Have each student write a short description of another group's model, using academic language and key vocabulary, including map essentials. Have students share their descriptions orally with the class.